Structure and Transformation of Matter

A basic understanding of matter is essential to the conceptual development of other big ideas in science. In the elementary years of conceptual development, students will be studying properties of matter and physical changes of matter at the macro level through direct observations, forming the foundation for subsequent learning. During the middle years, physical and chemical changes in matter are observed, and students begin to relate these changes to the smaller constituents of matter—namely, atoms and molecules. By high school, students will be dealing with evidence from both direct and indirect observations (microscopic level and smaller) to consider theories related to change and conservation of matter. The use of models (and an understanding of their scales and limitations) is an effective means of learning about the structure of matter. Looking for patterns in properties is also critical to comparing and explaining differences in matter.

End of Primary	4th Grade	5th Grade
Physical Science		
SC-P-1.1.1 Students will classify material objects by their properties. Objects are made of one or more materials such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made. Those properties and measurements of the objects can be used to separate or classify objects or materials. DOK 2		**SC-M5-1.1.1 Students will describe the physical properties of substances (e.g., boiling point, solubility, density).** A substance has characteristic physical properties (e.g., boiling point, solubility, density) that are independent of the amount of the sample. DOK 2
SC-P-1.1.2 Students should understand that objects have many observable properties such as size, mass, shape, color, temperature, magnetism, and the ability to interact and/or to react with other substances. Some properties can be measured using tools such as metric rulers, balances, and thermometers.		
SC-P-1.1.3 Students will describe the properties of water as it occurs as a solid, liquid, or gas. Matter (i.e., water) can exist in different states--solid, liquid, and gas. Properties of those states of matter can be used to describe and classify them. DOK 2	**SC-E4-1.1.1** **Students will explain how matter, including water, can be changed from one state to another.** Materials can exist in different states--solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling. Resulting cause and effect relationships should be explored, described and predicted. DOK 3	

Motion and Forces

Whether observing airplanes, baseballs, planets, or people, the motion of all bodies is governed by the same basic rules. In the elementary years of conceptual development, students need multiple opportunities to experience, observe, and describe (in words and pictures) motion, including factors (i.e., pushing and pulling) that affect motion. At the middle level, qualitative descriptions of the relationship between forces and motion will provide the foundation for quantitative applications of Newton's Laws. These ideas are more fully developed at the high school level along with the use of models to support evidence of motion in abstract or invisible phenomena such as electromagnetism.

End of Primary	4th Grade	5th Grade
Physical Science		
SC-P-1.2.1 Students will describe and make inferences about the interactions of magnets with other magnets and other matter (e.g., magnets can make some things move without touching them). Magnets have observable properties that allow them to attract and repel each other, and magnets attract certain kinds of other materials (e.g., iron). Based on the knowledge of the basic properties of magnets, predictions can be made and conclusions drawn about their interactions with other common objects. DOK 2	**SC-E4-1.2.1 Students will interpret or represent data related to an object's straight-line motion in order to make inferences and predictions of changes in position and/or time.** An object's motion can be described by measuring its change in position over time such as rolling different objects (e.g., spheres, toy cars) down a ramp. Collecting and representing data related to an object's motion provides the opportunity to make comparisons and draw conclusions. DOK 3	**SC-M5-1.2.1 Students will interpret data in order to make qualitative (e.g., fast, slow, forward, backward) and quantitative descriptions and predictions about the straight-line motion of an object.** The motion of an object can be described by its relative position, direction of motion, and speed. That motion can be measured and represented on a graph. DOK 3
SC-P-1.2.2 Students will describe the change in position over time (motion) of an object. An object's motion, such as rolling different objects (e.g., spheres, toy cars) down a ramp, can be observed, described, compared, and graphed by measuring its change in position over time. DOK 2	**SC-E4-1.2.2 Students will infer causes and effects of pushes and pulls (forces) on objects based on representations or interpretations of straight-line movement/motion in charts, graphs, and qualitative comparisons.** The position and motion of objects can be changed by pushing or pulling. The amount of change is related to the force (defined as the strength of the push or pull) used. The force with which a ball is hit illustrates this principle. Cause and effect relationships, along with predicted consequences related to the strength of pushes and pulls (force) on an object's position and motion should be explored and qualitatively compared. DOK 3	*SC-M5-1.2.2 Students should understand that forces are pushes and pulls, and that these pushes and pulls may be invisible (e.g., gravity, magnetism) or visible (e.g., friction, collisions).*
SC-P-1.2.3 Students will describe the position and motion of objects and predict changes in	**SC-E4-1.2.3 Students will compare the rate of vibration to the pitch of sound that is**	

position and motion as related to the strength of pushes and pulls. The position and motion of objects can be changed by pushing or pulling. The amount of change in position and motion is related to the strength of the push or pull (force). The force with which a ball is hit illustrates this principle. By examining cause and effect relationships related to forces and motions, consequences of change can be predicted. DOK 2	**produced in order to make inferences and predictions about the pitch of a sound based on graphical and observational data.** Vibration is a type of motion that can be observed, measured, and described. Sound is produced by vibrating objects. The pitch of the sound can be varied by changing the rate of vibration. Relationships between the rate of vibration and the produced sound can be represented graphically. Inferences based on graphical and observational data can be used to make predictions about vibration rates and pitch. DOK 3	
SC-P-1.2.4 Students should understand that the position of an object can be described by locating it relative to another object or the background. The position can be described using phrases such as to the right, to the left, 50 cm from the other object.		
SC-P-1.2.5 Students will • **explain that sound is a result of vibrations, a type of motion;** • **describe pitch (i.e., high, low) as a difference in sounds that are produced.** Vibration is a type of motion that can be observed, described, measured and compared. Sound is produced by vibrating objects. The pitch of the sound can be varied by changing the rate of vibration. The relationship between rates of vibration and produced sounds can be described and graphed. DOK 2		

The Earth and the Universe

The Earth system is in a constant state of change. These changes affect life on earth in many ways. Development of conceptual understandings about processes that shape the Earth begin at the elementary level with understanding *what* Earth materials are and that change occurs. At the middle level, students investigate *how* these changes occur. Finally, at the high school level, most of the emphasis is on *why* these changes occur. An understanding of systems and their interacting components will enable students to evaluate supporting theories of earth changes.

At the heart of elementary students' initial understanding of the Earth's place in the universe is direct observation of the earth-sun-moon system. Students can derive important conceptual understandings about the system as they describe interactions resulting in shadows, moon phases, and day and night. The use of models and observance of patterns to explain common phenomena is essential to building a conceptual foundation and supporting ideas with evidence at all levels. In middle school, students begin to look beyond what can be directly observed as they explore the earth-sun-moon system, as well as the rest of our solar system, employing the concept of scale within their models. Patterns play an important role as students seek to develop a conceptual understanding of gravity in their world and in the universe. High school is the time to bring all of the ideas together to look at the universe as a whole. Students will use evidence to evaluate and analyze theories related to the origin of the universe and all components of the universe.

End of Primary	4th Grade	5th Grade
Earth/Space Science		
SC-P-2.3.1 Students will describe and classify earth materials (solid rocks, soils, water, and gases of the atmosphere) using their properties. Earth materials include solid rocks and soils, water, and the gases of the atmosphere. Minerals that make up rocks have properties of color, luster and hardness. Soils have properties of color, texture, the capacity to retain water, and the ability to support plant growth. Water on Earth and in the atmosphere can be a solid, liquid, or gas. Opportunities should be provided for observing, classifying, describing, discovering/identifying patterns, formulating questions, and designing simple investigations dealing with Earth materials in order to understand what those materials really are and how they change. DOK 2	**SC-E4-2.3.1 Students will:** • **classify earth materials by the ways that they are used;** • **explain how their properties make them useful for different purposes.** Earth materials provide many of the resources humans use. The varied materials have different physical and chemical properties that can be used to describe, separate, sort, and classify them. Inferences about the unique properties of the earth materials yield ideas about their usefulness. For example, some are useful as building materials (e.g., stone, clay, marble), some as sources of fuel (e.g., petroleum, natural gas), or some for growing the plants we use as food. DOK 2	**SC-M5-2.3.1 Students will** • **describe the circulation of water (evaporation and condensation) from the surface of the Earth, through the crust, oceans, and atmosphere (water cycle);** • **explain how matter is conserved in this cycle.** Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Students should have experiences that contribute to the understanding of evaporation, condensation, and the conservation of matter. DOK 2
SC-P-2.3.2 Students will describe weather and weather data, looking for patterns, in order to make simple predictions based on those patterns discovered.	**SC-E4-2.3.2 Students will describe and explain consequences of changes to the surface of the Earth, including some common fast changes (e.g., landslides, volcanic**	**SC-M5-2.3.2 Students will explain interactions of water with Earth materials and results of those interactions (e.g., dissolving minerals, moving minerals and gases).**

Weather changes from day to day and over seasons. Weather can be described using observations and measurable quantities such as temperature, wind direction and speed, and precipitation. Simple predictions can be made by analyzing collected data for patterns. DOK 2	**eruptions, earthquakes), and some common slow changes (e.g., erosion, weathering).** The surface of the Earth changes. Some changes are due to slow processes such as erosion or weathering. Some changes are due to rapid processes such as landslides, volcanic eruptions, and earthquakes. Observations of the changes can be used to identify cause and effect relationships. Consequences of the changes, along with evidence-based proposed solutions, should be explored. DOK 3	Water dissolves minerals and gases and may carry them to the oceans. Observations and models of this process should provide the basis for explanations related to the interacting components within this system. DOK 3
	SC-E4-2.3.3 Students will represent and interpret weather and weather data in order to make generalizations and/or predictions about weather changes from day to day and over seasons. Weather changes from day to day and over seasons. Weather can be described by observations and measurable quantities such as temperature, wind direction and speed, and precipitation. Data can be displayed and used to make predictions. DOK 3	**SC-M5-2.3.3 Students will** • **describe Earth's atmosphere as a relatively thin blanket of air consisting of a mixture of nitrogen, oxygen, and trace gases, including water vapor;** • **analyze atmospheric data in order to draw conclusions about real life phenomena related to atmospheric changes and conditions.** Earth is surrounded by a relatively thin blanket of air called the atmosphere. The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations. Conclusions based on the interpretation of atmospheric data can be used to explain real life phenomena (e.g., pressurized cabins in airplanes, mountain-climber's need for oxygen). DOK 3
SC-P-2.3.3 Students will describe the properties, locations, and real or apparent movements of objects in the sky (e.g., Sun, clouds, moon). Objects in the sky (e.g., Sun, clouds, moon) have properties, locations, and real or apparent movements that can be observed and described. Observational data, patterns, and models should be used to describe real or apparent movements. DOK 2	**SC-E4-2.3.4 Students will interpret a variety of representations/models (e.g., diagrams, sundials, distance of sun above horizon) of the sun's movement in the sky to identify patterns, recognize relationships, and draw conclusions about the Earth-Sun system.** Changes in movement of objects in the sky have patterns that can be observed, described, and modeled. The Sun appears to move across the sky in the same way every day, but the Sun's apparent path changes slowly over seasons. Data collected can be	**SC-M5-2.3.4 Students will** • **analyze global patterns of atmospheric movement;** • **explain the basic relationships of patterns of atmospheric movement to local weather.** Global patterns of atmospheric movement can be observed and/or analyzed by interpreting patterns within data. Atmospheric movements influence local weather. Oceans have a major effect on climate,

	changes slowly over seasons. Data collected can be used to identify patterns, recognize relationships, and draw conclusions about the Earth and Sun system. DOK 3	because water in the oceans holds a large amount of heat. Related data can be used to predict change in weather and climate. Consequences of these changes should be explored and discussed. DOK 3
SC-P-2.3.4 Students will describe the movement of the sun in the sky using evidence of interactions of the sun with the earth (e.g., shadows, position of sun relative to horizon) to identify patterns of movement. Changes in movement of objects in the sky have patterns that can be observed and described. The Sun appears to move across the sky in the same way every day, but the Sun's apparent path changes slowly over seasons. Opportunities should be provided to make observations and recognize relationships between movements of objects and resulting phenomena, such as shadows, in order to make predictions and conclusions about those movements. DOK 2	*SC-E4-2.3.5 Students should understand that the moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon can be described as it changes from day to day in a cycle that lasts about a month.*	**SC-M5-2.3.5 Students will compare components of our solar system, including using models/representations that illustrate the system and resulting interactions.** Earth is the third planet from the Sun in a system that includes the moon, the Sun, eight other planets and their moons, and smaller objects. The Sun, an average star, is the central and largest body in the solar system. Use of models/diagrams will provide understanding of scale within the solar system. DOK 2
SC-P-2.3.5 Students should understand that the moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon can be described as it changes from day to day in a cycle that lasts about a month.		

Unity and Diversity

All matter is comprised of the same basic elements, goes through the same kinds of energy transformations, and uses the same kinds of forces to move. Living organisms are no exception. Elementary students begin to observe the macroscopic features of organisms in order to make comparisons and classifications based upon likenesses and differences. Looking for patterns in the appearance and behavior of an organism leads to the notion that offspring are much like the parents, but not exactly alike. In middle school, students begin to compare, contrast, and classify the microscopic features of organisms—the cells, as well as investigate reproduction as the essential process to the continuation of all species. Expected patterns of genetic traits are predicted. Distinctions are made between learned behaviors and inherited traits. At the high school level, an in-depth study of the specialization and chemical changes occurring at the cellular level builds upon the foundational ideas developed earlier to investigate DNA and effects of alterations in DNA for an individual organism as well as for a species. Emphasis at every level should be placed upon the understanding that while every living thing is composed of similar small constituents that combine in predictable ways, it is the subtle variations within these small building blocks that account for both the likenesses and differences in form and function that create the diversity of life.

End of Primary	4th Grade	5th Grade
Biological Science		
SC-P-3.4.1 Students will explain the basic needs of organisms. Organisms have basic needs. For example, animals need air, water, and food; plants need air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met. Based on observations of plants and animals in controlled settings, simple investigable questions should be posed, simple investigations designed, resulting data collected and analyzed, and consequences of similar situations predicted. DOK 2	**SC-E4-3.4.1 Students will** • **compare the different structures and functions of plants and animals that contribute to the growth, survival and reproduction of the organisms;** • **make inferences about the relationship between structure and function in organisms.** Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking. Evidence about the relationship between structure and function should be used to make inferences and draw conclusions. DOK 3	**SC-M5-3.4.1 Students will describe and compare living systems to understand the complementary nature of structure and function.** Observations and comparisons of living systems at all levels of organization illustrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, tissues, organs, organ systems, organisms (e.g., bacteria, protists, fungi, plants, animals), and ecosystems. Explorations of the relationship between structure and function provide the basis for comparisons and classification schemes. DOK 2

SC-P-3.4.2 Students should understand that things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).	*SC-E4-3.4.2 Students should understand that things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).*	**SC-M5-3.4.2 Students will explain the essential functions of cells necessary to sustain life.** Cells carry on the many functions needed to sustain life. Models of cells, both physical and analogical, promote understanding of their structures and functions. Cells grow and divide, thereby producing more cells. This requires that they take in nutrients, which provide energy for the work that cells do and make the materials that a cell needs. DOK 2
SC-P-3.4.3 Students will describe the basic structures and related functions of plants and animals that contribute to growth, reproduction, and survival. Each plant or animal has observable structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking. These observable structures should be explored to sort, classify, compare and describe organisms. DOK 2	**SC-E4-3.4.3 Students will** • **compare a variety of life cycles of plants and animals;** • **draw conclusions in order to classify and make inferences about an organism.** Plants and animals have life cycles that include the beginning of life, growth and development, reproduction, and death. The details of a life cycle are different for different organisms. Observations of actual organisms or models of organisms' life cycles should be used to classify and make inferences about an organism. DOK 3	*SC-M5-3.4.3 Students should understand that all organisms are composed of cells, the fundamental unit of life. Most organisms are single cells; other organisms, including plants and animals are multicellular.*
SC-P-3.4.4 Students will • **compare a variety of plant and animal life cycles to understand patterns of the growth, development, reproduction, and death of an organism;** • **describe similarities and differences that allow for the classification of organisms.** Plants and animals have life cycles that include the beginning of life, growth and development, reproduction, and death. The details of a life cycle are different for different organisms. Observations of different life cycles should be made in order to identify patterns and recognize similarities and differences that would allow classification of the cycles. DOK 2	**SC-E4-3.4.4 Students will identify some characteristics of organisms that are passed from the parents, and others that are learned from interactions with the environment.** Observations of plants and animals yield the conclusion that organisms closely resemble their parents at some time in their life cycle. Some characteristics (e.g., the color of flowers, the number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a bicycle, and these cannot be passed on to the next generation. Explorations related to inherited versus learned characteristics should offer opportunities to collect data and draw conclusions about various groups of organisms. DOK 2	

Biological Change

The only thing certain is that everything changes. Elementary students build a foundational knowledge of change by observing slow and fast changes caused by nature in their own environment, noting changes that humans and other organisms cause in their environment, and observing fossils found in or near their environment. At the middle school level, students study relationships among populations and ecosystems that contribute to the success or demise of a specific population or species. Students construct basic explanations that can account for the great diversity among organisms. The stage is set for high school students to evaluate the role natural selection plays in the diversity of species. Modern ideas of evolution provide a scientific explanation for three main sets of observable facts about life on earth: the enormous number of different life forms we see about us, the systematic similarities in anatomy and molecular chemistry we see within that diversity, and the sequence of changes in fossils found in successive layers of rock that have been formed over more than a billion years (*Science for All Americans, p. 67)*.

End of Primary	4th Grade	5th Grade
SC-P-3.5.1 Students will describe fossils as evidence of organisms that lived long ago, some of which may be similar to others that are alive today. Fossils found in Earth materials provide evidence about organisms that lived long ago and the nature of the environment at that time. Making observations of fossils, describing them and using those descriptions as evidence to draw conclusions about the organisms and basic environments represented by the fossils should occur in order to promote understanding. DOK 2	**SC-E4-3.5.1 Students will use representations of fossils to** • **draw conclusions about the nature of the organisms and the basic environments that existed at the time;** • **make inferences about the relationships to organisms that are alive today.** Fossils found in Earth materials provide evidence about organisms that lived long ago and the nature of the environment at that time. Making observations of fossils, describing them and using those descriptions as evidence to draw conclusions about the organisms and basic environments represented by the fossils should occur in order to promote understanding. DOK 3	**SC-M5-3.5.1 Students will describe cause and effect relationships between enhanced survival/reproductive success and particular biological adaptations (e.g., changes in structures, behaviors, and/or physiology) to generalize about the diversity of species.** Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Examining cause and effect relationships between enhanced survival/reproductive success and biological adaptations (e.g., changes in structures, behaviors, and/or physiology), based on evidence gathered, creates the basis for explaining diversity. DOK 2
		SC-M5-3.5.2 Students should understand that all organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.

Energy Transformations

Energy transformations are inherent in almost every system in the universe—from tangible examples at the elementary level, such as heat production in simple earth and physical systems to more abstract ideas beginning at middle school, such as those transformations involved in the growth, dying and decay of living systems. The use of models to illustrate the often invisible and abstract notions of energy transfer will aid in conceptualization, especially as students move from the macroscopic level of observation and evidence (primarily elementary school) to the microscopic interactions at the atomic level (middle and high school levels). Students in high school expand their understanding of constancy through the study of a variety of phenomena. Conceptual understanding and application of the laws of thermodynamics connect ideas about matter with energy transformations within all living, physical, and earth systems.

End of Primary	4th Grade	5th Grade
Unifying Ideas		
SC-P-4.6.1 Students will describe basic relationships of plants and animals in an ecosystem (food chains). Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants. Basic relationships and connections between organisms in food chains can be used to discover patterns within ecosystems. DOK 2	**SC-E4-4.6.1 Students will analyze patterns and make generalizations about the basic relationships of plants and animals in an ecosystem (food chain).** Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants. Basic relationships and connections between organisms in food chains can be used to discover patterns within ecosystems. DOK 2	**SC-M5-4.6.1 Students will** • **classify energy phenomena as kinetic or potential;** • **describe the transfer of energy occurring in simple systems or related data.** Energy can be classified as kinetic or potential. Energy is a property of many substances and energy can be found in several different forms. For example, chemical energy as found in food we eat or in the gasoline we burn in our car. Heat, light (solar), sound, electrical energy and the energy associated with motion (called kinetic energy) are examples of other forms of energy. Objects can also have energy simply by virtue of their position, called potential energy. Energy is transferred in many ways. Simple systems should be observed, and relevant data collected, in order to describe the transfer of energy occurring. DOK 2

SC-P-4.6.2 Students will describe evidence of the sun providing light and heat to the Earth. Simple observations and investigations begin to reveal that the Sun provides the light and heat necessary to maintain the temperature of Earth. Based on those experiences, the conclusion can be drawn that the Sun's light and heat are necessary to sustain life on Earth. DOK 2	**SC-E4-4.6.2 Students will** • **analyze data/evidence of the Sun providing light and heat to earth;** • **use data/evidence to substantiate the conclusion that the Sun's light and heat are necessary to sustaining life on Earth.** Simple observations, experiments and data collection begin to reveal that the Sun provides the light and heat necessary to maintain the temperature of Earth. Evidence collected and analyzed should be used to substantiate the conclusion that the sun's light and heat are necessary to sustain life on Earth. DOK 3	*SC-M5-4.6.2 Students should understand that the Sun is a major source of energy for changes on Earth's surface. The Sun loses energy by emitting light. A tiny fraction of that light reaches Earth, transferring energy from the Sun to Earth.*
SC-P-4.6.3 Students will analyze models of basic electrical circuits using batteries, bulbs, and wires, in order to determine whether a simple circuit is open or closed. Electricity in circuits can produce light. Describing and comparing models demonstrates basic understanding of circuits. DOK 2	**SC-E4-4.6.3 Students will evaluate a variety of models/representations of electrical circuits (open, closed, series, and/or parallel) to** • **make predictions related to changes in the system;** • **compare the properties of conducting and non-conducting materials.** Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete conducting path through which an electrical current can pass. Analysis of a variety of circuit models creates an opportunity to make predictions about circuits, as well as to demonstrate an understanding of the concepts of open and closed circuits and basic conducting and non-conducting materials. DOK 3	**SC-M5-4.6.3 Students will** • **draw conclusions about the transfer of energy within models/representations of electrical circuits as evidenced by the heat, light, sound, and magnetic effects that are produced;** • **describe changes within the system that would affect the transfer of energy.** Electrical circuits provide a means of transferring electrical energy. This transfer can be observed and described as heat, light, sound, and magnetic effects are produced. Models and diagrams can be used to support conclusions and predict consequences of change within an electrical circuit. DOK 3

SC-P-4.6.4 Students will • **describe light as traveling in a straight line until it strikes an object;** • **classify materials according to their properties of interaction with light (i.e., reflects, absorbs).** Light can be observed and described as it travels in a straight line until it strikes an object. Light can be reflected by a shiny object (e.g., mirror, spoon), refracted by a lens (e.g., magnifying glass, eyeglasses), or absorbed by an object (e.g., dark surface). Comparisons and classifications of interactions between surfaces and light can be observed and described based on evidence gained through simple investigations based on student generated questions. DOK 2	**SC-E4-4.6.4 Students will** • **analyze models/representations of light in order to generalize about the behavior of light.** • **represent the path of light as it interacts with a variety of surfaces (i.e, reflecting, refracting, absorbing).** Light can be observed as traveling in a straight line until it strikes an object. Light can be reflected by a shiny object (e.g., mirror, spoon), refracted by a lens (e.g., magnifying glass, eyeglasses), or absorbed by an object (e.g., dark surface). Questions posed about the behavior and interaction of light with a variety of surfaces, can be explored through investigations using simple equipment. DOK 3	**SC-M5-4.6.4 Students will identify predictable patterns and make generalizations about light and matter interactions using data/evidence.** Light energy interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). Questions related to these phenomena should drive the design of simple investigations that will yield evidence of the predictable patterns associated with these interactions. DOK 3
	SC-E4-4.6.5 Students will • **identify ways that heat can be produced (e.g. burning, rubbing) and properties of materials that conduct heat better than others ;** • **describe the movement of heat between objects.** Heat can be produced in many ways such as burning or rubbing. Heat moves from a warmer object to a cooler one by contact (conduction) or at a distance. Some materials absorb and conduct heat better than others. Simple investigations can illustrate that metal objects conduct heat better than wooden objects. DOK 2	*SC-M5-4.6.5 Students should understand that heat energy moves in predictable ways, flowing from warmer objects to cooler ones, until both objects reach the same temperature. By examining cause and effect relationships, consequences of heat movement and conduction can be predicted and inferred.*

Interdependence

It is not difficult for students to grasp the general notion that species depend on one another and on the environment for survival. But their awareness must be supported by knowledge of the kinds of relationships that exist among organisms, the kinds of physical conditions that organisms must cope with, the kinds of environments created by the interaction of organisms with one another and their physical surroundings, and the complexity of such systems. Elementary learners need to become acquainted with ecosystems that are easily observable to them by beginning to study the habitats of many types of local organisms. Students begin to investigate the survival needs of different organisms and how the environment affects optimum conditions for survival. In middle school, students should be guided from specific examples of the interdependency of organisms to a more systematic view of the interactions that take place among organisms and their surroundings. At the high school level, the concept of an ecosystem should bring coherence to the complex array of relationships among organisms and environments that students have encountered. Students growing understanding of systems in general will reinforce the concept of ecosystems. Stability and change in ecosystems can be considered in terms of variables such as population size, number and kinds of species, productivity, and the effect of human intervention. (*adapted from Benchmarks for Science Literacy)*

End of Primary	4th Grade	5th Grade
Unifying Ideas		
SC-P-4.7.1 Students will describe the cause and effect relationships existing between organisms and their environments. The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations. Observations should be made of a number of different environments in order to discover patterns and resulting cause and effect relationships between organisms and their environments. Connections and conclusions should be made based on the observable or collected data. DOK 2	**SC-E4-4.7.1 Students will make predictions and/or inferences based on patterns of evidence related to the survival and reproductive success of organisms in particular environments.** The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations. Observations should be made of a number of different environments in order to discover patterns and resulting cause and effect relationships between organisms and their environments. Connections and conclusions should be made based on the observable or collected data. DOK 3	**SC-M5-4.7.1 Students will** • **describe and categorize populations of organisms according to the function they serve in an ecosystem (e.g., producers, consumers, decomposers);** • **draw conclusions about the effects of changes to populations in an ecosystem.** Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem. Using data gained from observing interacting components within an ecosystem, the effects of changes can be predicted. DOK 3

	SC-E4-4.7.2 Students will • **describe human interactions in the environment where they live;** • **classify the interactions as beneficial or harmful to the environment using data/evidence to support conclusions.** All organisms, including humans, cause changes in the environment where they live. Some of these changes are detrimental to the organism or to other organisms; other changes are beneficial (e.g., dams built by beavers benefit some aquatic organisms but are detrimental to others). By evaluating the consequences of change using cause and effect relationships, solutions to real life situations/dilemmas can be proposed. DOK 3	*SC-M5-4.7.2 Students should understand that a population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.*